

Improving Curriculum and Patient Care:

*Areas of Weakness Identified through the
“Emergent/Critical Care Imaging
Simulation”*

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Emergent/Critical Care Imaging Simulation



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What are we trying to Simulate?

*ALL of the skills necessary for service as a
radiologist performing
Emergent and Critical Care Imaging*

Skills Needed in Emergent and Critical Care Imaging

- *Observational skills*
- *Confident Determination of Normal*
- *Identification of Key Findings*
- *Recognition of Acuity*
- *Communication of Results*
- *Initiation of Appropriate Action*
- *Stamina*

The “Front End”

1. Create the Case Curriculum:

- *Collect Cases for Case Library*
- *HIPAA Compliant case data*
- *Full DICOM Image set*
- *Normal and Abnormal Cases*

The “Front End”

2. Create the Simulation:

- *Balance across Body System*
- *Balance across Modality*
- *Publish (Web-based Delivery) to participating training programs*

The “Front End”

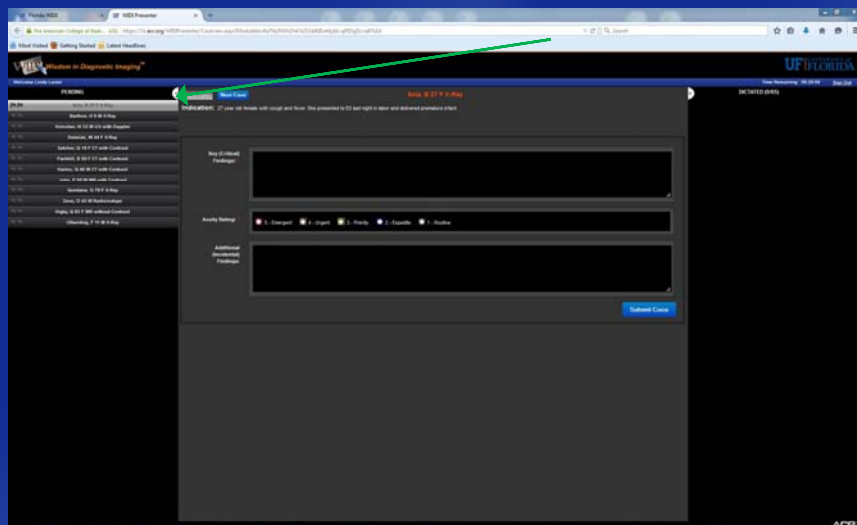
3. Administer the Simulation:



The “User Experience”

- PACS Workstation
 - Typical Work Flow Style
 - 65 Cases (all systems, all modalities)
 - Normal and Abnormal Cases
 - Variation in ACUITY
 - 8 Hour Shift
- (Mimics true ED experience ... minus the phone calls, interruptions

LEFT SCREEN: User picks a case from the workflow...



WISDM Wisdom in Diagnostic Imaging™

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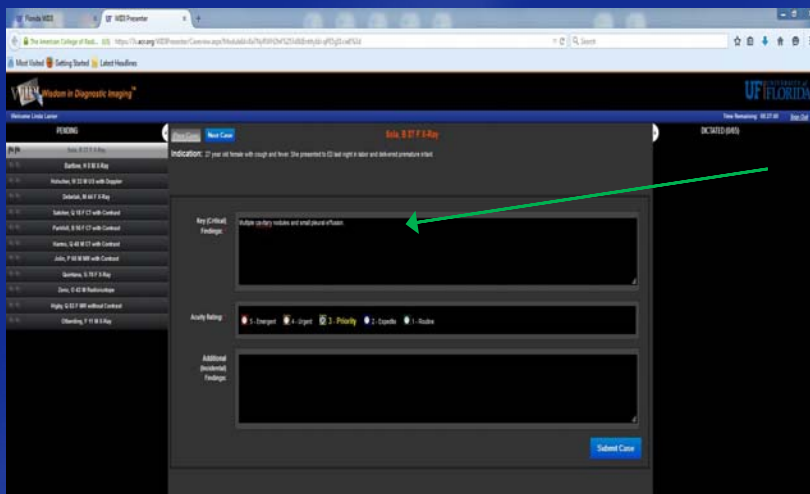
RIGHT SCREEN: View full DICOM set with image manipulation tools



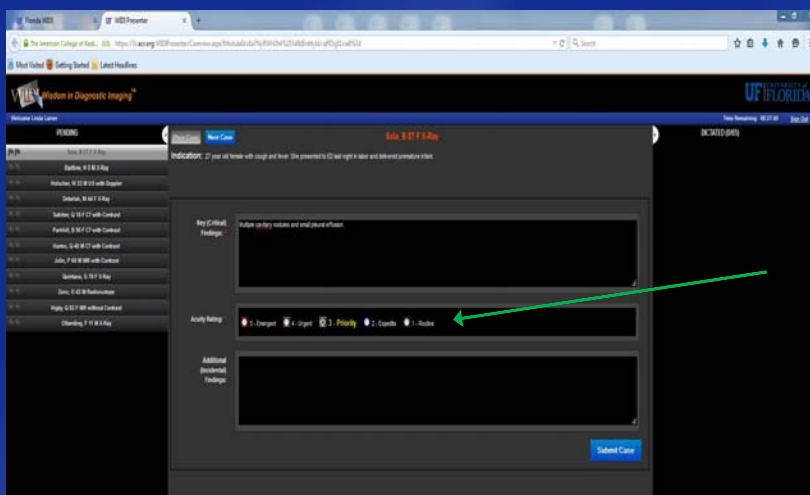
WISDM Wisdom in Diagnostic Imaging™

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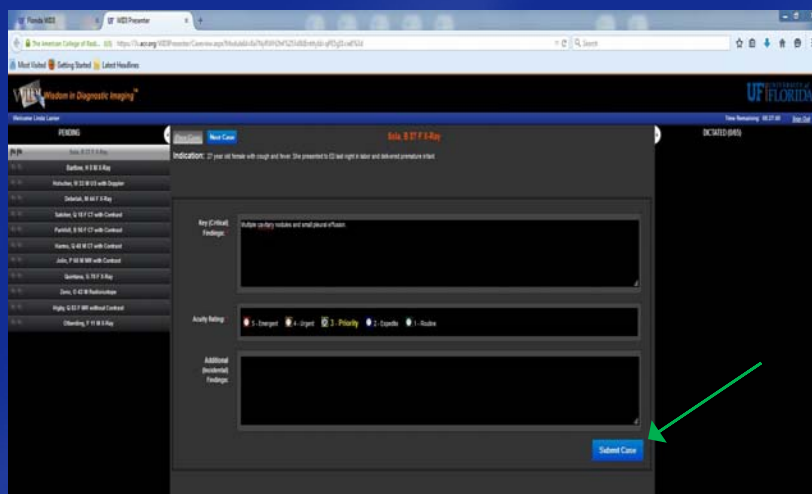
*LEFT SCREEN: User enters free text response ...
(no cuing)*



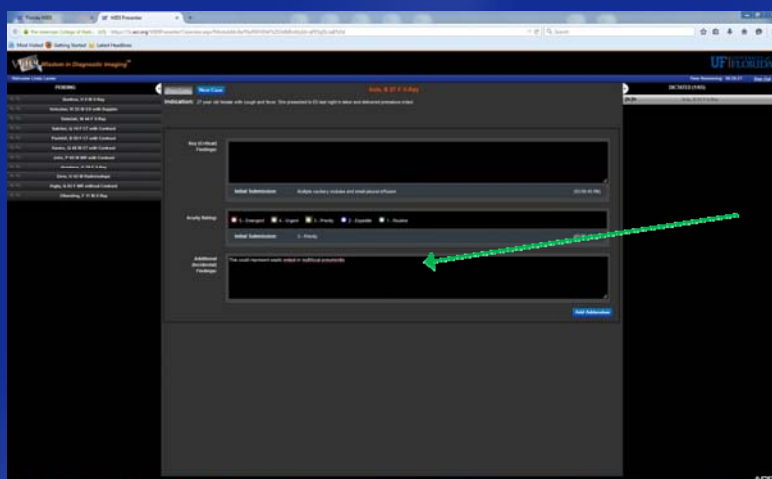
...and selects acuity level ...



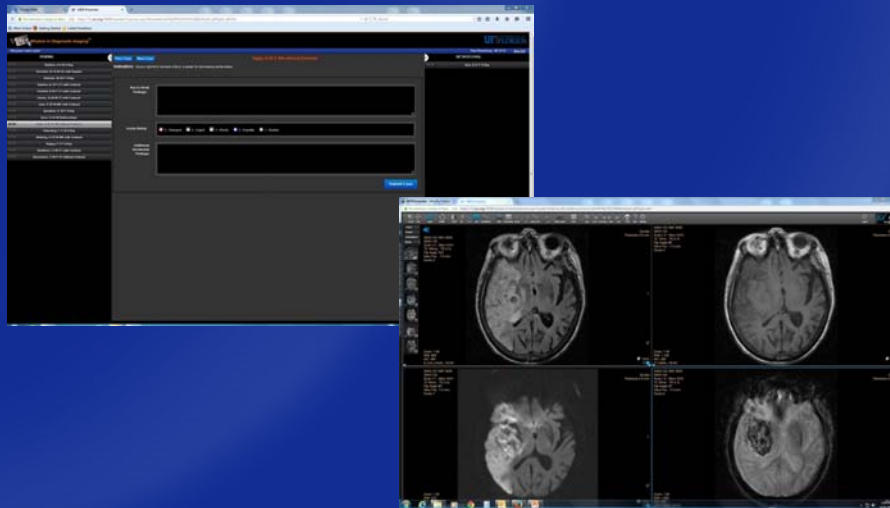
... and submits case...



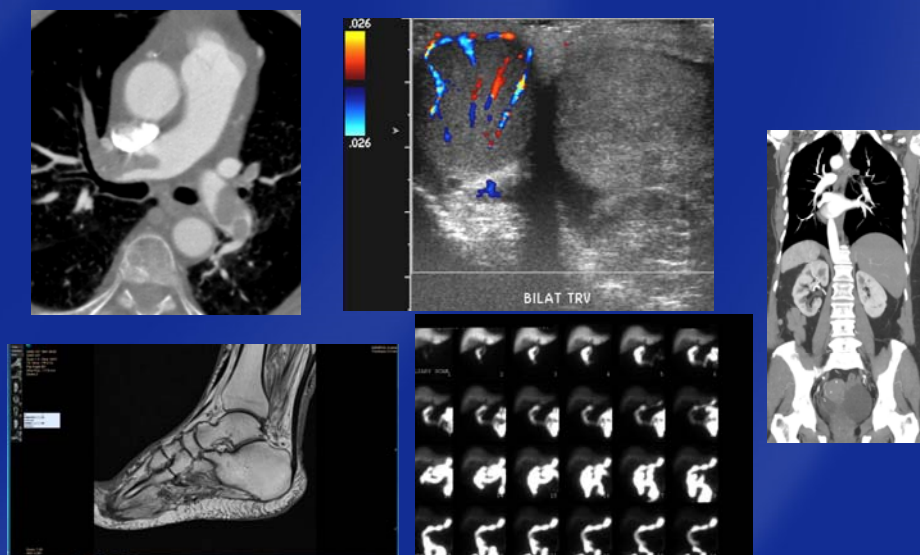
Ooops ... need addendum ? User can re-access case and enter an addendum



Continue through exercise by selecting a new case from workflow list



Varied Case content



The "Back End"

Grading

1. Score against Key
2. Indicate Error Type

Type	User Response Text	Answer Key	Score	Error Type
Key Findings	Diverticulosis with mild perforations but surrounding air/fluid levels suggestive of mild diverticulitis. No abscess. Normal appendix. No stones.	<ul style="list-style-type: none"> T Diverticulocolonoscopy (112, 111, 8) T No renal stone or obstruction, 1 T Recommended MRI spine, 1 D Evaluation of endplates (only) D Reactive bone at endplate (only) D Soft tissue swelling (only) 1 F Normal F Calcifications F renal stone 	0	<input checked="" type="checkbox"/> (1) Observational <input type="checkbox"/> (2) Interpretive <input type="checkbox"/> (3) Descriptive Only <input type="checkbox"/> (4) Key/Lethal Miss
Additional Findings	Distended GB with air/fluid levels. No acute cholecystitis. No large pancreatic mass or CBD stone seen on CT.		0	
Acuity Rating	3 - Priority		0	
Total Score			Total 0	



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The "Back End"

Results and Analysis sent to Program Director:

1. Group Results

Group Score Range		Faculty Eval		First Year Residents														
Total Score	%	%	%	Sub-Specialty Scores														
				GI	GU	HR	Hemat	Mus Med	Viscer	Rep/Inf	GI	GU	HR	Hemat	Mus Med	Viscer	Rep/Inf	
85%	86%	82%	88%	62%	67%	50%	58%	61%	75%	83%	87%	87%	100%					
82%	86%	77%	77%	87%	17%	33%	50%	31%	100%	92%	83%	83%	100%					
86%	86%	82%	88%	58%	67%	83%	39%	44%	100%	67%	67%	67%	100%					
82%	77%	80%	84%	54%	54%	33%	67%	47%	72%	75%	83%	50%	50%	83%				
81%	83%	84%	84%	50%	50%	25%	42%	39%	50%	75%	100%	87%	83%					
80%	75%	80%	75%	62%	67%	67%	67%	40%	80%	80%	80%	72%	67%	100%				
2nd Year Group Average		70%		Second Year Residents														
Total Score	%	%	%	Sub-Specialty Scores														
				GI	GU	HR	Hemat	Mus Med	Viscer	Rep/Inf	GI	GU	HR	Hemat	Mus Med	Viscer	Rep/Inf	
78%	82%	81%	8%	67%	83%	50%	67%	80%	100%	100%	67%	100%						
74%	82%	77%	27%	54%	33%	75%	75%	72%	100%	92%	100%	100%	83%					
72%	82%	88%	77%	17%	67%	75%	61%	75%	92%	100%	100%	100%	87%					
88%	82%	88%	38%	77%	100%	50%	50%	50%	100%	100%	100%	100%	83%	100%				
88%	82%	84%	30%	37%	83%	58%	54%	39%	100%	83%	50%	83%	83%	100%				
80%	82%	8%	8%	60%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%



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The “Back End”

Results and Analysis to Program Director:

2. Individual Resident Results

Emergency/Critical Care Simulation SIM 2016 SAMPLE Medical Center Individual Results			
SAMPLE RESIDENT, MD #2			
Overall Simulation score - 73%			
Overall of Normal - 17%			
Score	Group Avg.	Range	
GI	69%	61%	46-89%
GU	96%	73%	56-96%
H&N	20%	34%	18-60%
MSK	64%	66%	53-73%
NEU	73%	62%	47-76%
Ped	92%	81%	65-92%
Rep/End	80%	57%	28-80%
CR	88%	80%	60-88%
VIR	53%	77%	53-100%
Missed (or very low partial score):			
GI:		Error Type(s):	
Meenteric Tear, Active Bleed		Interpretive	
Pancreatic Laceration/Contusion		Observational	
Esophageal Varices, Active Bleed		Observational	
MSK:			
Gilbreath Fracture/Dislocation		Observational	
Calcaneal Fracture		Observational	
Vascular Injury, Knee		Observational	
NEU:			
Discula/Osteomyelitis		Observational	
Ped:			
Necrotizing Enterocolitis		Observational	

The “Back End”

Results and Analysis to Program Director:

3. Topic areas for additional study

Topic areas that several residents in your program missed:

Epidural abscess
Coalescent mastoiditis/septic thrombus
Septic Joint MRI
Necrotizing fasciitis

Areas of mixed response: Consider topics for discussion/differentiation:

Aorta: transection/ATAI/dissection/rupture
Abscess: tonsillar/peritonsillar/retropharyngeal, vs uncomplicated tonsillitis
Eg: condylar/supracondylar/epicondylar
Misleading History: Be aware that the history given may be misleading. All of the histories on every case in the SIM are the actual word-for-word histories given to the radiologist when the case was originally interpreted. Discussion topic: Do not be “lulled into only looking where the history leads you to look”.

Reasons for partial credit instead of full credit:

1. NOT MAKING THE CRITICAL CALL (but rather just descriptive findings:) specifically in non-accidental trauma, ruptured ectopic pregnancy, ruptured AAA, necrotizing fasciitis, free air/perforated viscus, and other life threatening scenarios.
2. Associated observations not addressed:
 - a. C-spine fractures – if they did not discuss involvement of the transverse foramen, e.g., potential vascular injury.
 - b. Heart strain in case of PE
 - c. Presence or absence of free fluid in ectopic; presence or absence of complications of appendicitis; vascular status in cases of ischemia, etc.

Video Review of Cases Feedback/education for Residents



Emergent/Critical Care Imaging Simulation

2011-2016

YEAR	SIMULATION	PARTICIPATING INSTITUTIONS	TOTAL RESIDENTS	R LEVELS	AVERAGE	RANGE
2011	SIM 1	1	22	R1-12	62%	48-72%
				R2-10	77%	72-81%
2012	SIM 1	3	36	R1-20	60%	42-74%
				R2-16	74%	53-82%
2013	SIM1	4	66	R1-25	60%	49-74%
				R2-24	74%	65-85%
				R3-11	73%	60-85%
				R4 - 6	78%	73-81%
2014	SIM 2	9	103	R1-63	59%	39-78%
				R2-31	70%	48-81%
				R3 - 6	66%	54-72%
				R4 - 3	68%	59-79%
2015	SIM 3	17	129	R1-95	59%	47-68%
				R2-34	67%	63-74%
2016	SIM 4	26	201	R1-126	56%	22-86%
				R2 -54	66%	47-84%
				R3 -11	73%	62-84%
				R4 -10	75%	67-83%

Simulation – A Self Discovery Process

- *Identifies the Educational Tasks*
- *Identifies the Knowledge Gaps*
 - *Individuals*
 - *Programs*
 - *Across institutions*
- *Identifies Areas of Uncertainty*
- *Curriculum -Trains Toward Competency*

Areas of Weakness Identified

Method

- **212 Residents / 16 Institutions**
 - 148/R1
 - 64/R2
- **129 Cases**
 - Normal and Abnormal
 - All Modalities
 - All Systems
 - All ages
- **Categories**
 - Body, Neuro, MSK
- **Grading**
 - Score of 0-10
 - Faculty Graders (4)
 - Predetermined key(s)

Method

- **Fixed Effects**
 - Modality, Category, Pt. Age, Pt. Gender, Normal/Abnormal, Acuity, Resident Training Level
- **Random Effects**
 - Grader, Resident Program, Residents ID (blinded), Case ID
- **Specific Analysis**
 - Average score
 - Score distribution (specifically score of < 3)
 - Category
 - Performance regarding Modality
 - Performance regarding Resident Training Level

Results - Summary

- 97% Grader reliability
- Lower performance on CR
 - Mean score 6.29/10, $p=0.0642$
- Lower category performance in Neuro
 - Mean score 5.71/10, $p=.0001$
- Higher scores corresponded to increased training levels
- Specific topics identified with low scores across all institutions and training levels (Table 1)

*Table 1: Eight “Gaps”
Across Institutions and Training Levels*

Category	Topic	Modality	% scoring 0 - 3 pts	AVG SCORE	AVG SCORE
				R1 (n=148)	R2 (n=64)
Neuro	Suppurative Adenitis	CT w	100%	2	3
	Hyperdense Basilar Artery	CT w/o	90%	11	6
	Discitis/Osteomyelitis	CR	90%	3	8
	Cerebellar Edema	CT w/o	85%	12	18
	Lemierre’s	CT w	71%	17	23
	Chiari I	CT w/o	71%	21	27
MSK	Lytic Lesion-pelvis (Burkitts)	CR	72%	18	40
Ped.	Non Accidental Trauma	CR	75%	17	25

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